A Status Update for the FLASHFlux Working Group

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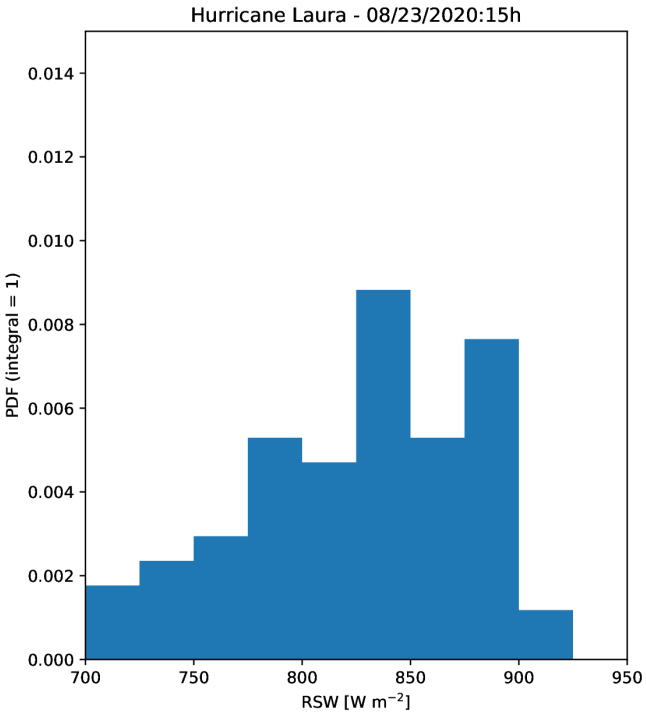
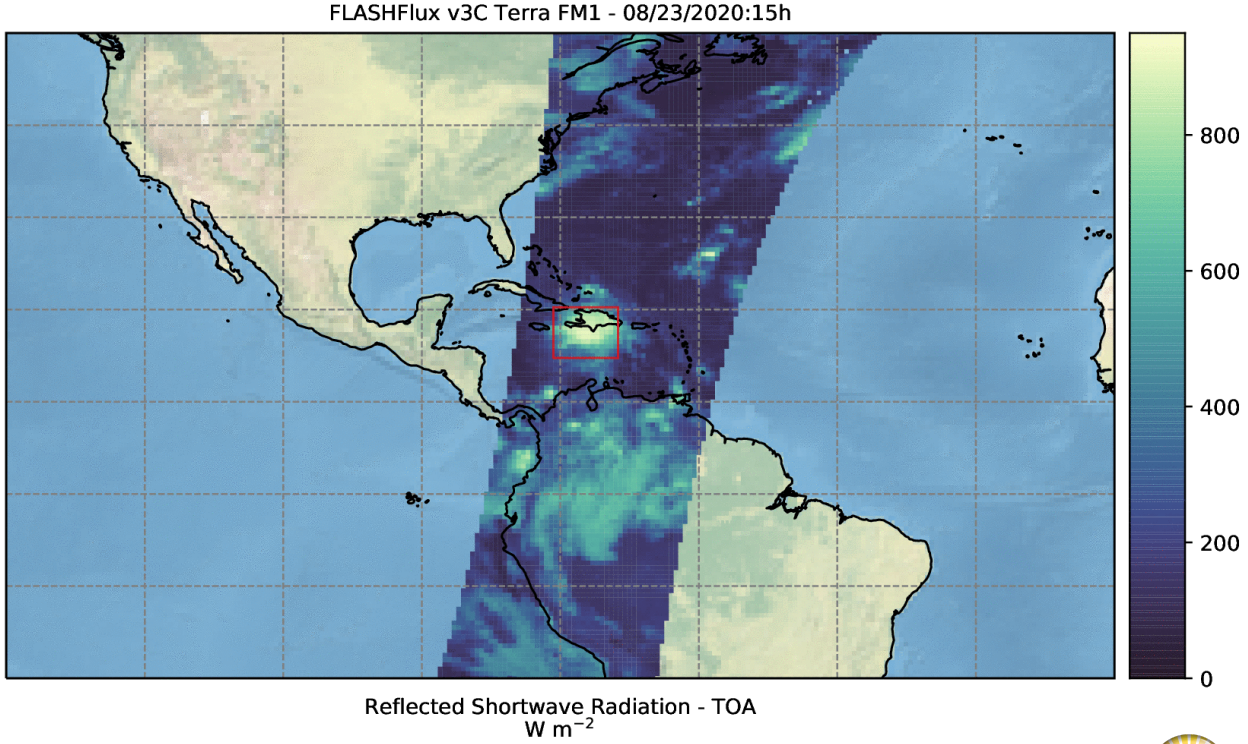
CERES FLASHFlux Overview

- ***FLASHFlux Overview***
  - Uses CERES based production system through inversion
  - Periodic calibration updates projected forward; running 3-day TISA
  - LPSA/LPLA SOFA algorithms for surface fluxes
- ***FLASHFlux Latency Objectives***
  - SSF products within 4 days
  - Global 1x1 daily averages from FF TISA (uses a running 3-day average); goal: 6-7 days latency
- ***FLASHFlux Usages***
  - Primarily used for applied science and education (i.e., POWER and Globe Clouds)
  - Supports also QC for selected missions (e.g., NOAA NESDIS)
  - TOA gridded fluxes; normalized to TOA EBAF for annual “State of the Climate” assessments (most recent report revised Mar. 2020).

Hurricane Laura Landfall From a CERES Perspective

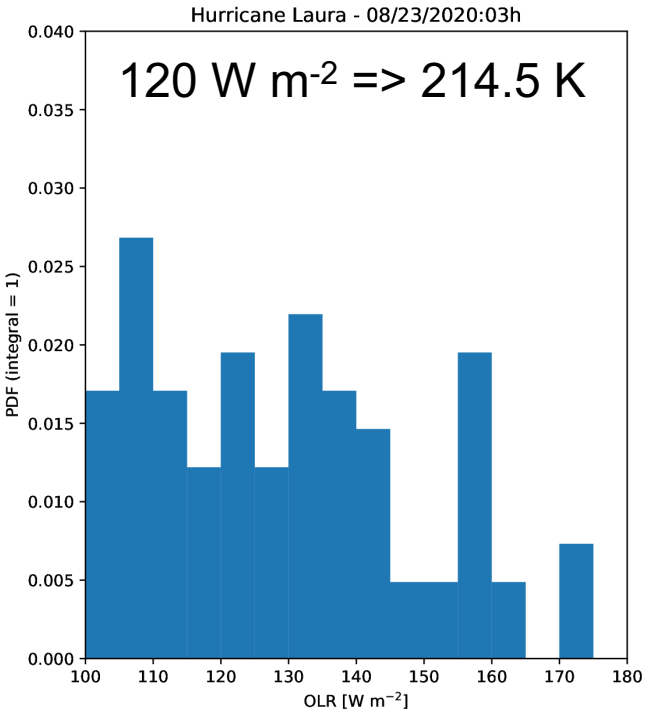
FLASHFlux v3C – Terra FM1 – Daytime RSW

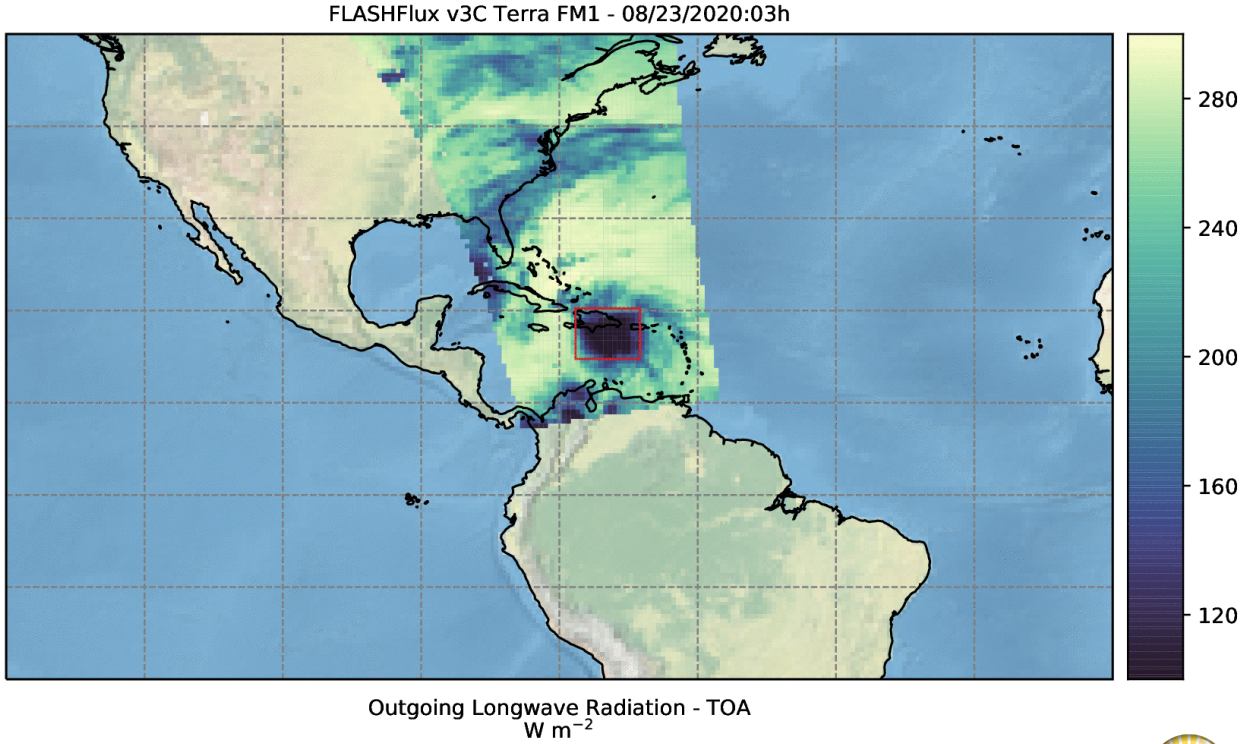




Hurricane Laura Landfall From a CERES Perspective

FLASHFlux v3C – Terra FM1 – Daytime & Nighttime OLR





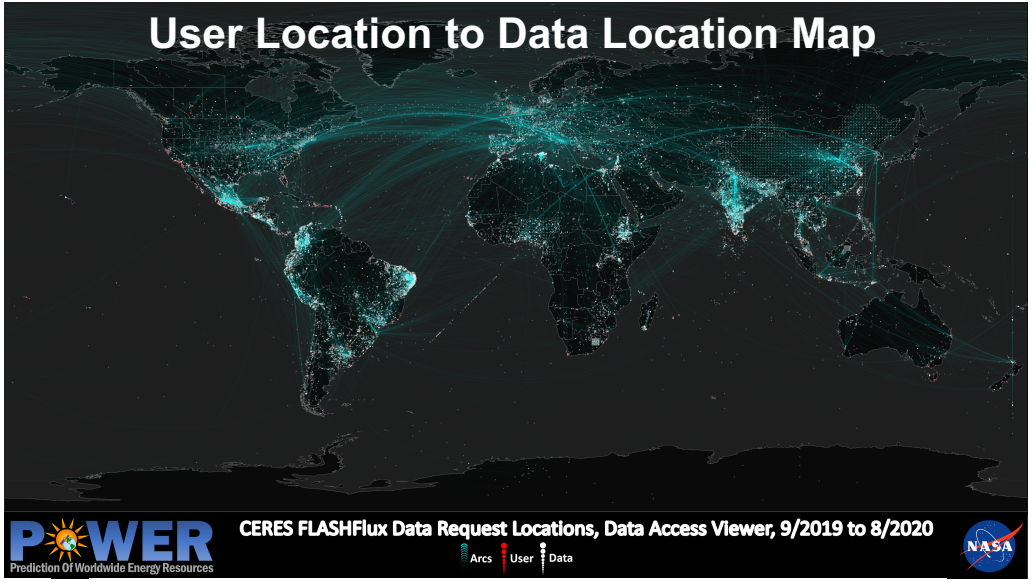
FLASHFlux Data Delivery via POWER (2019/09/01 to 2020/08/31)

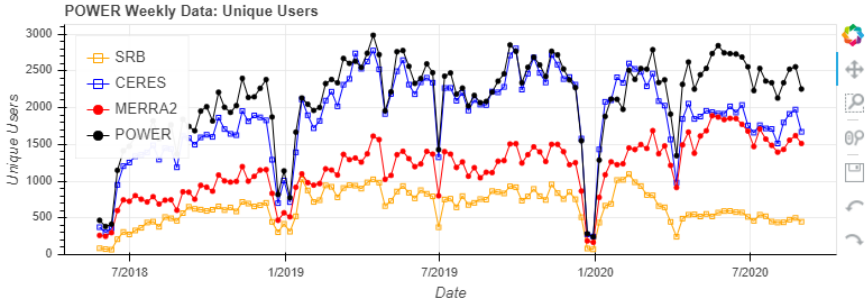
All FLASHFlux Orders Delivered via POWER

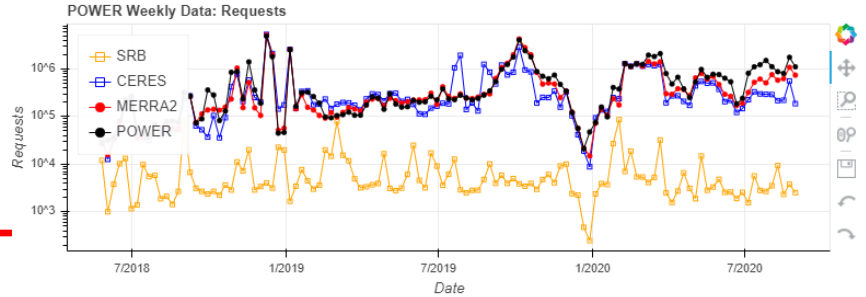
	Total	Monthly
Unique Users IPs	82,100	7,768
Requests	25,953,830	2,162,819

FLASHFlux Low Latency Orders Delivered via POWER

	Total	Monthly
Unique Users IPs	26,503	2,493
Requests	15,629,427	1,302,452
Latency < 2 Weeks %	60.22%	67.82%





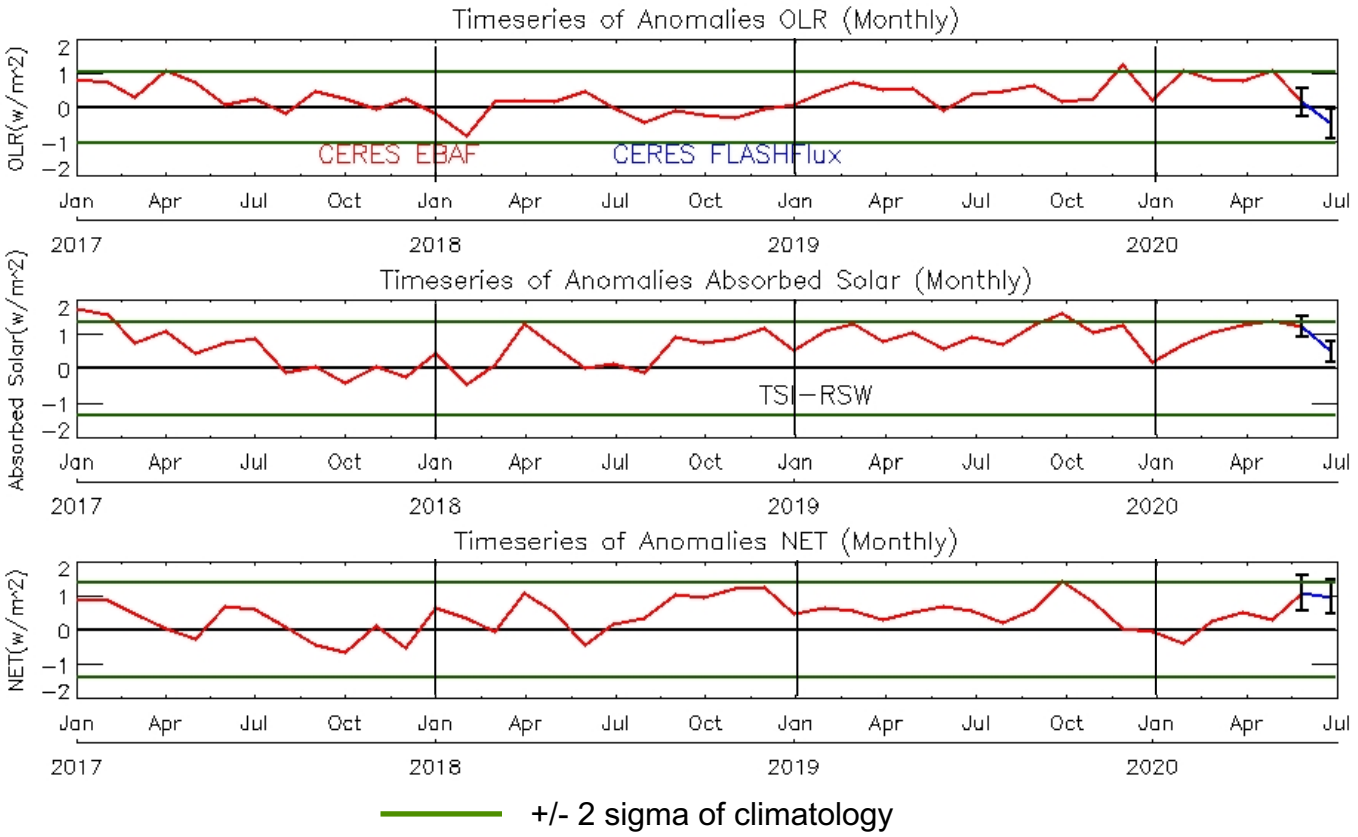


TOA Anomaly Time Series for State of the Climate

"State of Climate" 2019 published by AMS in August

Last few months

- OLR anomalies drop to ~ -0.5 W m^{-2}
- Net RSW (absorbed SW) anomalies reduce to ~0.5 W m^{-2}
- Total Net holds steady near 1 W m^{-2} by July 2020.
- Transition to La Nina?



FLASHFlux Production Status

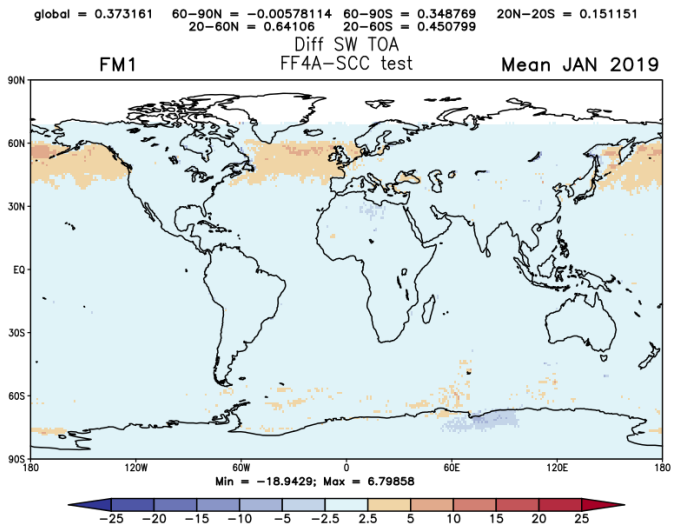
- ***Production with v3C (MODIS C5/C6/C6.1) (since Jan 1, 2017)***
  - FLASHFlux SSF for Aqua through 8/16 9:36 UT, Terra through 9/6
  - FLASHFlux TISA available via CERES subsetter, ASDC and specialized formats through POWER web portal (power.larc.nasa.gov) 5-6 day latency normally
  - Production ceased after TISA products for 8/15 due to Aqua anomaly; Terra-only mode failed
- ***Production with v4A Begun (since Aug 1, 2020)***
  - Identified and eliminate bug in first version of FF v4A; superseded by new version
  - New FF v4A SSF and TISA v4A production begun:
    - Products available starting data date 8/1/2020 (available v4A SSF Terra/Aqua through 8/13; TISA 8/11)
    - Will initially process 8/16/20 through 9/3/20 in “Terra-only” mode (hopefully this week); NOAA-20?
  - Evaluating v3C, 4A, and CERES Ed4 SSF
- ***FLASHFlux Information & Data Provision Through ...***
  - New CERES web site and subsetter both SSF and TISA
  - ASDC (via EarthData)

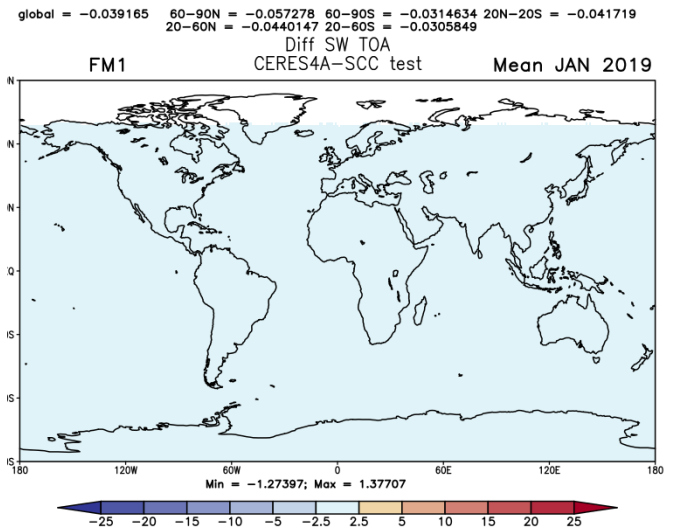
FLASHFlux Version 4A

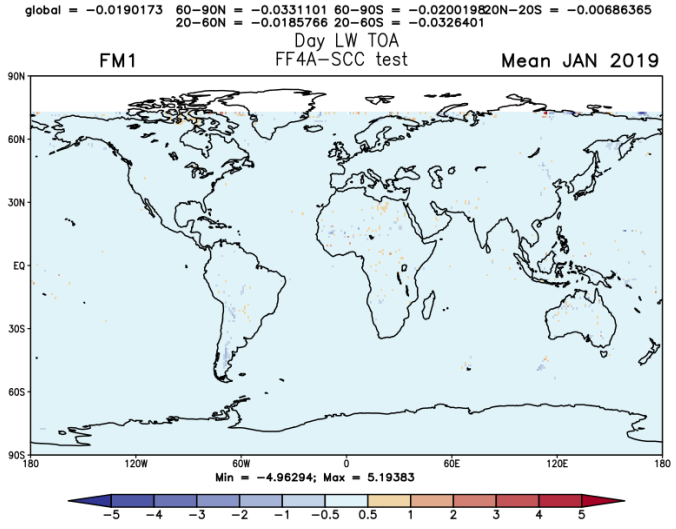
Attribute	FF v3C (MC6)	FF v4A
Baseline 1QC	Previous (Terra, Aqua)	4-5 month calibration Update Cycle (Terra, Aqua)
GEOS FP-IT input	GEOS 5.12.4	GEOS 5.12.4
MOA	Ed 4 compatible	Ed 4 compatible
MODIS	Collection 6.1	Collection 6.1
Clouds	Ed 2b w/ updated MC	Ed 4 w/ MC 6.1 calibration
SIBi (Snow/ICE Brightness Index)	No	Yes
Inversion (improved ADMs)	Ed 2	Ed 4
Aerosols	MATCH climatology	MATCH climatology
Flux Algorithm	Unchanged	Modified LPSA (new snow/ice parameterization)
TISA	Ed 2	Compatible w/ Ed 4 (current work)
Data Processed	SSF Terra 1/1/17 – 9/6/20; SSF Aqua & TISA (Terra+Aqua) 1/1/17 – 8/15/20	Planned to begin 8/1/20 (may reprocess backwards for 2020)
Validation Results	1/1/17 – 12/31/19	Jan, Apr, Jul, Oct 2019; 2020

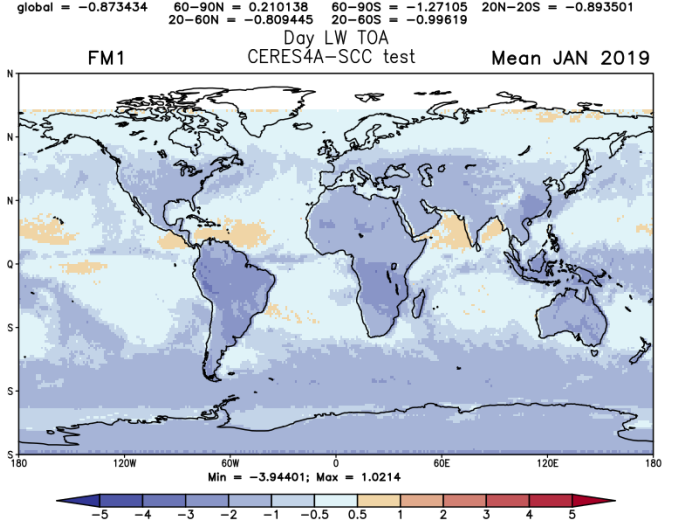
Assessing 4A with Calibration Sensitivity Runs

- Runs generated from special FF calibration from June 2019
- Compare FF4A (old), CERES Ed4 and special SCC run using Ed4 inputs and FF SCC
- SW TOA differences due to FF issue of **not properly sending O_3 path to Clouds**
- LW TOA @day due to calibration coefficients

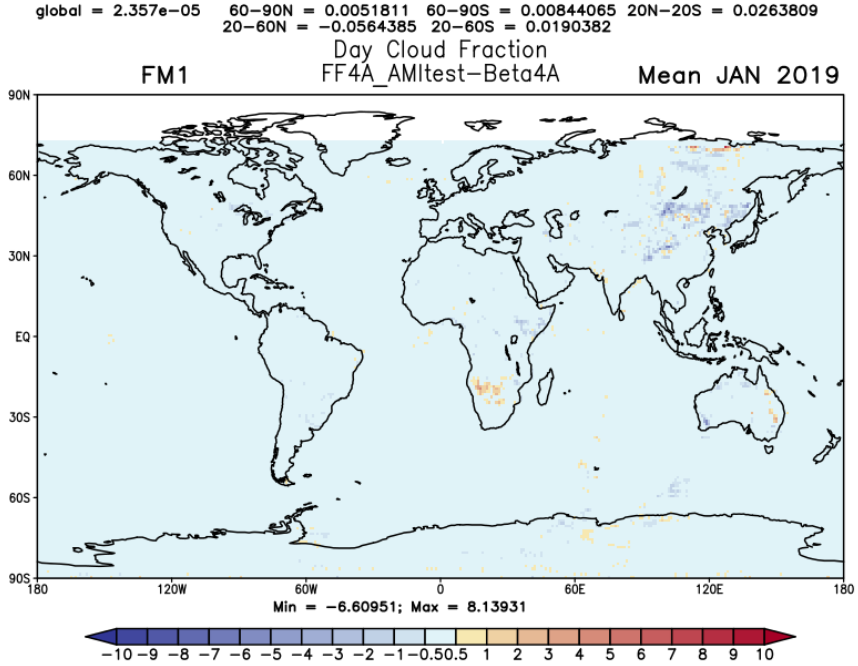


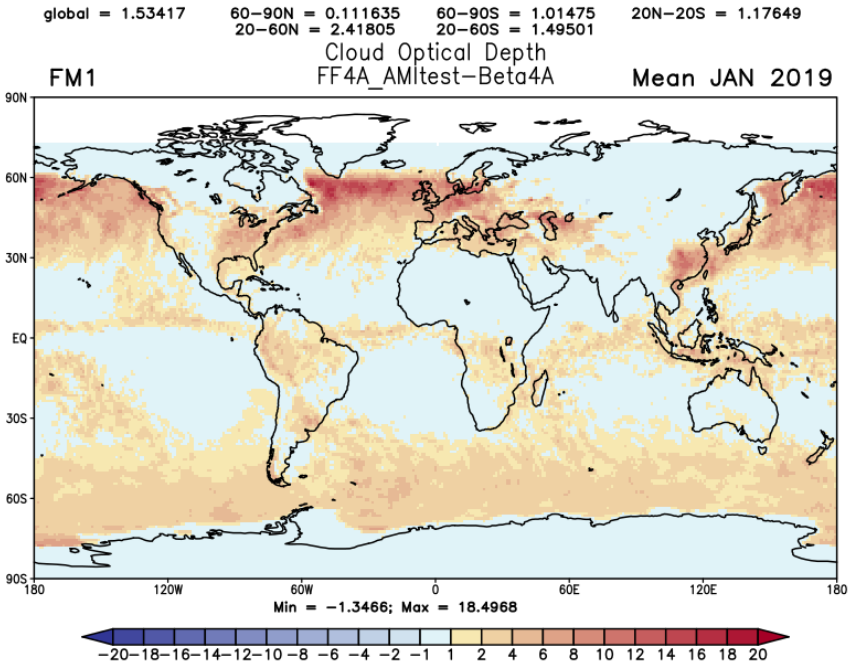






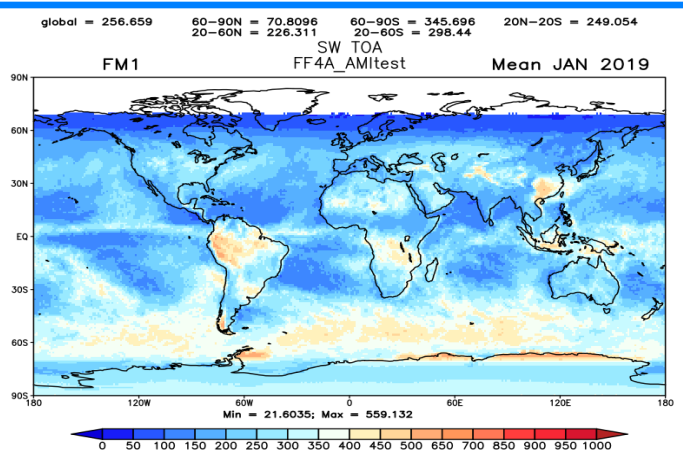
Cloud Property Changes for New FFv4A





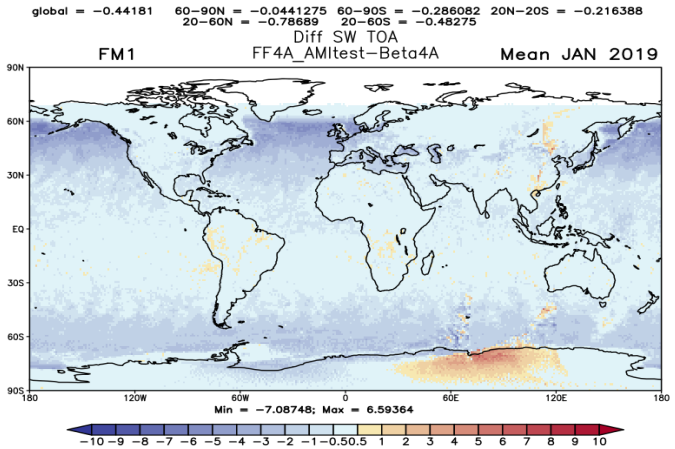
FF FM1 SSF TOA SW Flux Differences (Jan 2019)

Mean TOA SW up (including O_3)



New 4A – Old 4A:

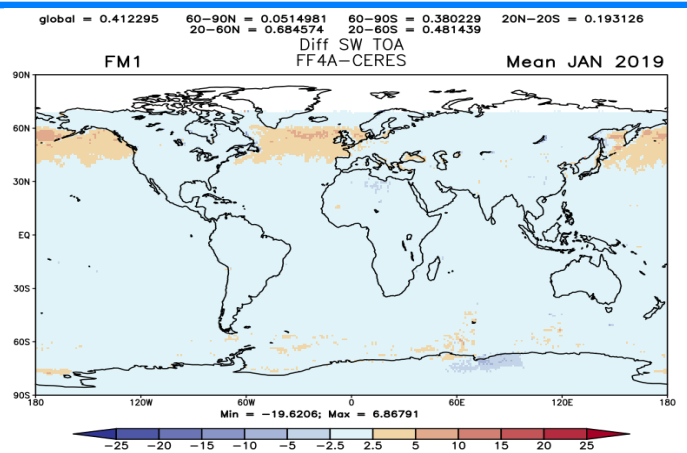
Reduction of fluxes due to ADM selection

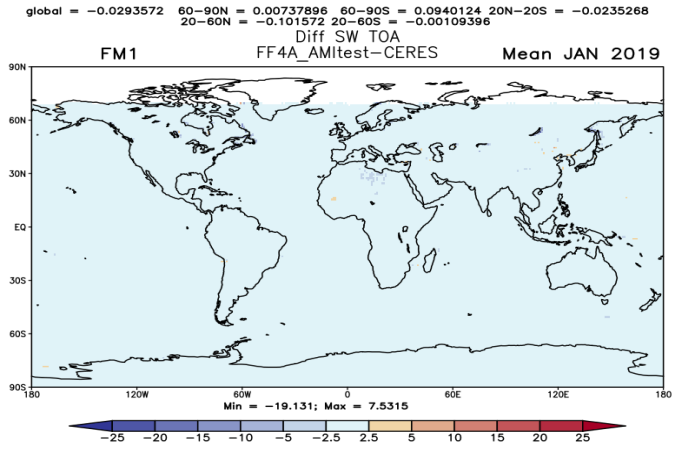


O_3 path leads to corrected reflected fluxes

New Global Calibration Mean Difference:

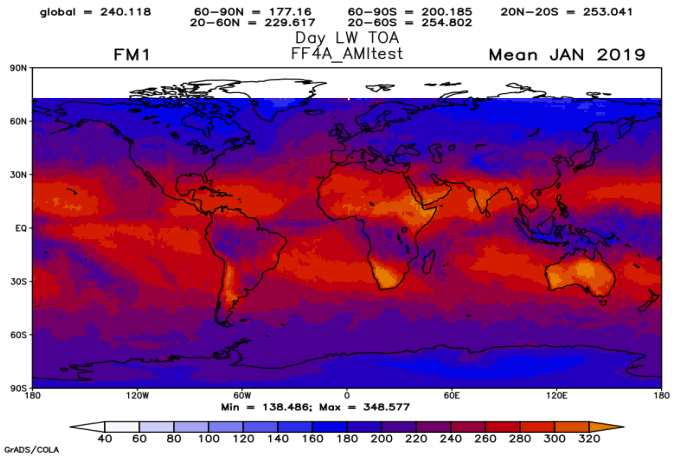
-0.01%



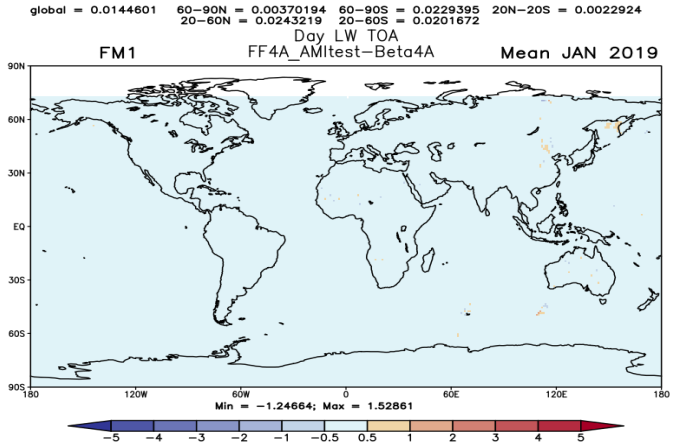


FF FM1 SSF TOA LW Day Flux Differences (Jan 2019)

Mean Daytime TOA LW

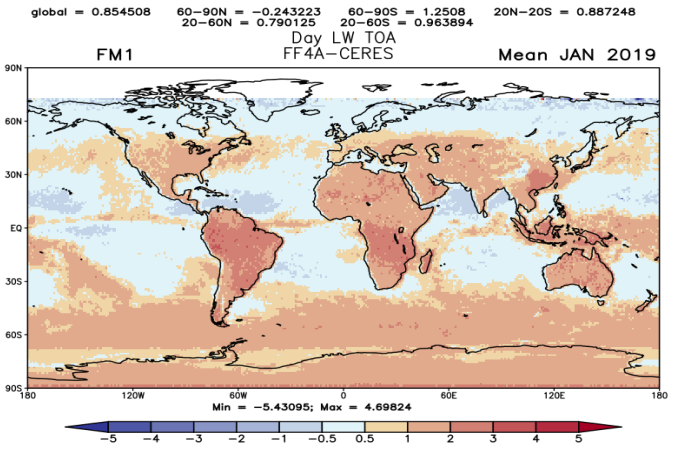


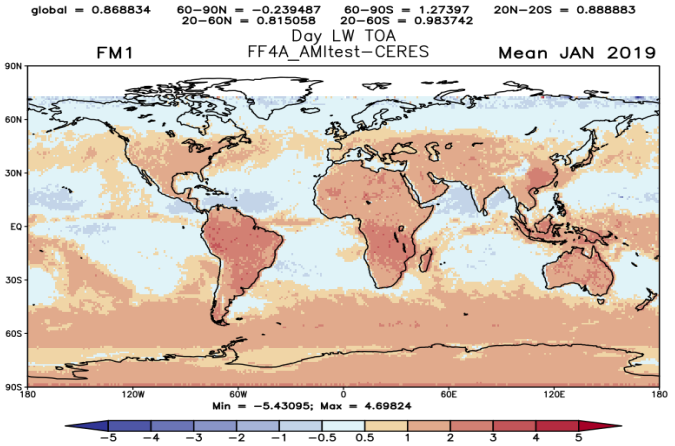
Neglecting O_3 little effect on TOA LW up



Global Calibration Mean Difference:

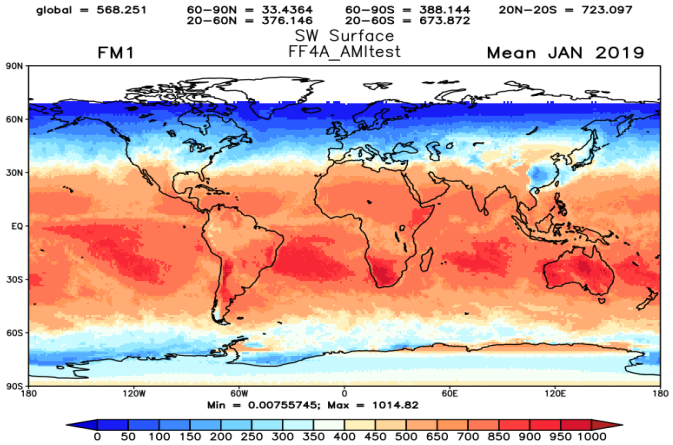
0.36%



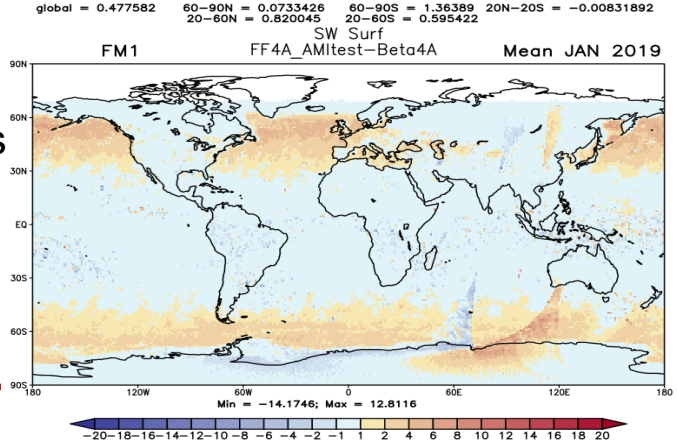


FF FM1 SSF Surface SW Flux Differences (Jan 2019)

Mean Surface SW Down

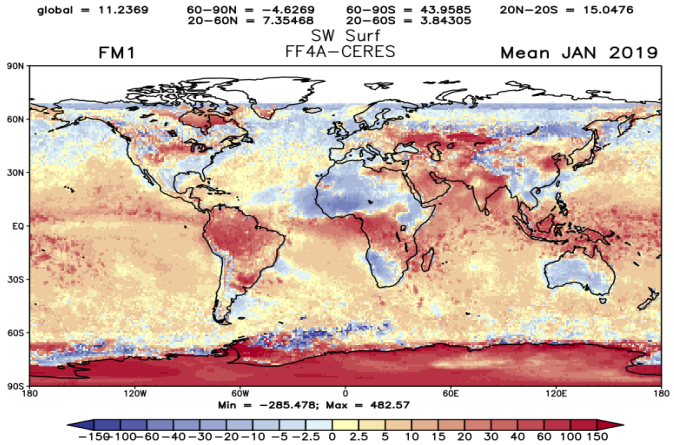


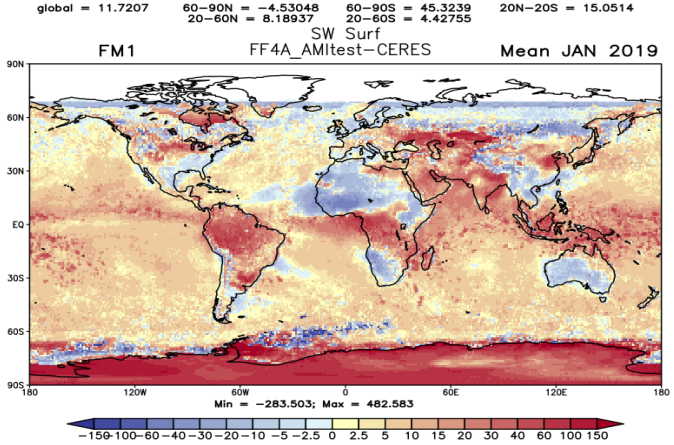
Differences consistent with TOA SW up



Small differences due to O3 correction don't affect general difference pattern

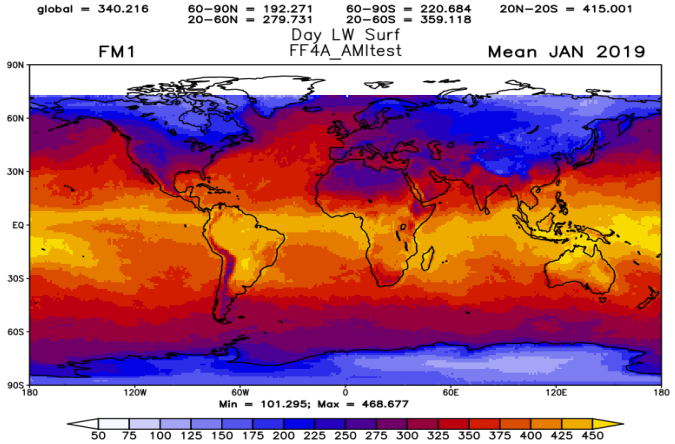
(2.2% global mean difference)



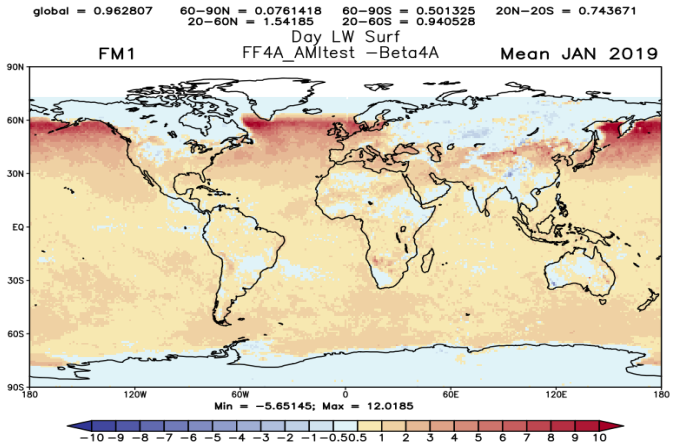


FM1 SSF Day Surface LW Flux Differences (Jan 2019)

Mean Surface SW Down

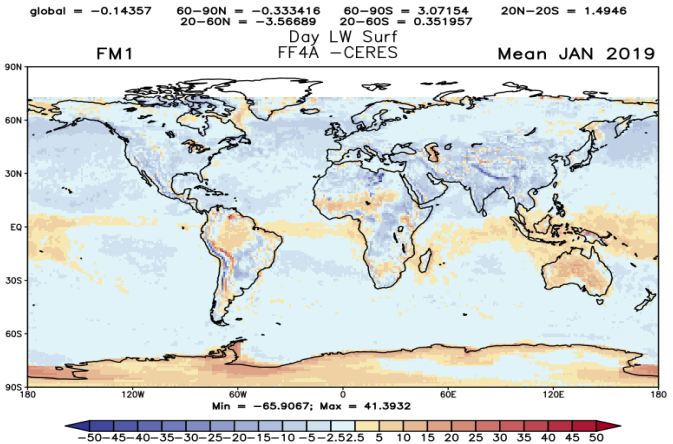


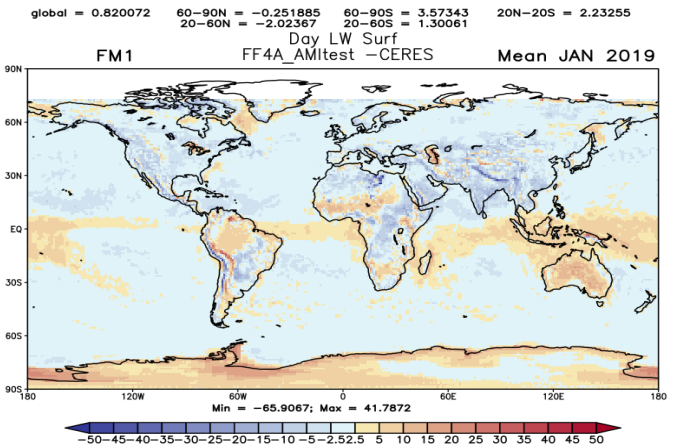
Differences consistent with cloud optical depth increases



Small differences due to O3 correction don't affect general difference pattern

Overall differences small





Terra/Aqua Monthly Flux Statistics (Jan 2019)

FM1 on Terra Jan 2019

	4Anew- 4Aold Mean / Std Dev (W m^{-2})	4Anew - FF3C Mean / Std Dev (W m^{-2})	4Anew-Ceres 4A Mean / Std Dev (W m^{-2})
TOA SW Up	-0.34 / 2.22	-0.10 / 7.07	0.08 / 2.81
TOA LW Up	0.02 / 0.50	0.52 / 2.23	0.39 / 1.39
Surf SW Dn	0.37 / 5.78	6.61 / 33.56	9.32 / 39.53
Surf LW Dn	0.43 / 1.25	2.54 / 12.68	1.17 / 9.06

FM1 on Terra July 2019

	4Anew- 4Aold Mean / Std Dev (W m^{-2})	4Anew - FF3C Mean / Std Dev (W m^{-2})	4Anew-Ceres 4A Mean / Std Dev (W m^{-2})
TOA SW Up	-0.48 / 2.43	-0.20 / 7.26	0.06 / 2.57
TOA LW Up	0.02 / 0.62	0.51 / 2.30	0.24 / 1.42
Surf SW Dn	0.45 / 6.44	2.43 / 23.05	5.14 / 27.63
Surf LW Dn	0.56 / 1.63	2.59 / 6.74	0.36 / 8.62

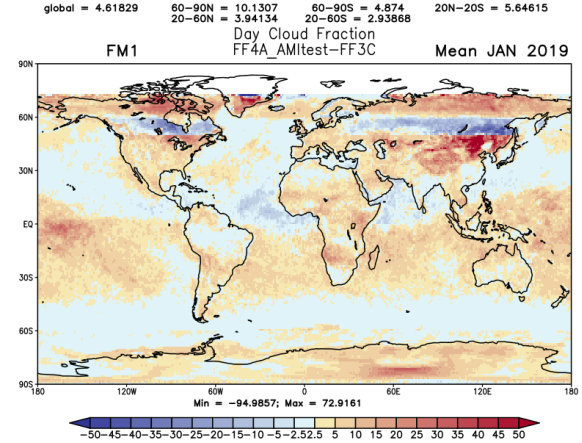
FM3 on Aqua Jan 2019

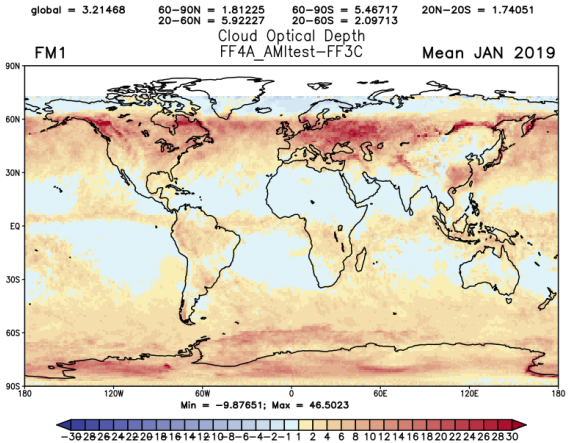
	4Anew- 4Aold Mean / Std Dev (W m^{-2})	4Anew - FF3C Mean / Std Dev (W m^{-2})	4Anew-Ceres 4A Mean / Std Dev (W m^{-2})
TOA SW Up	-0.35 / 2.19	-0.36 / 7.04	-0.04 / 2.35
TOA LW Up	0.01 / 0.59	0.28 / 2.60	-0.68 / 1.31
Surf SW Dn	0.37 / 5.97	6.31 / 30.60	8.71 / 37.68
Surf LW Dn	0.44 / 1.26	4.34 / 11.90	1.11 / 8.88

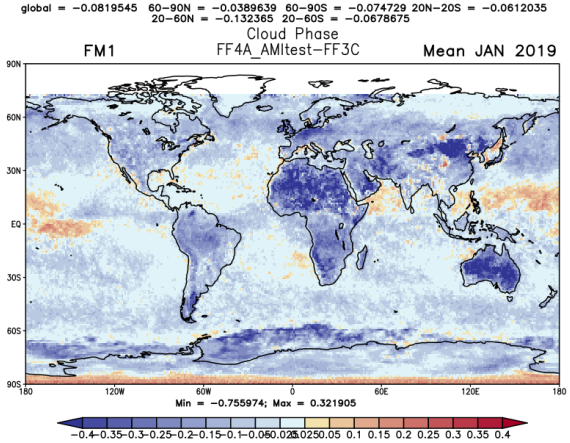
FM3 on Aqua July 2019

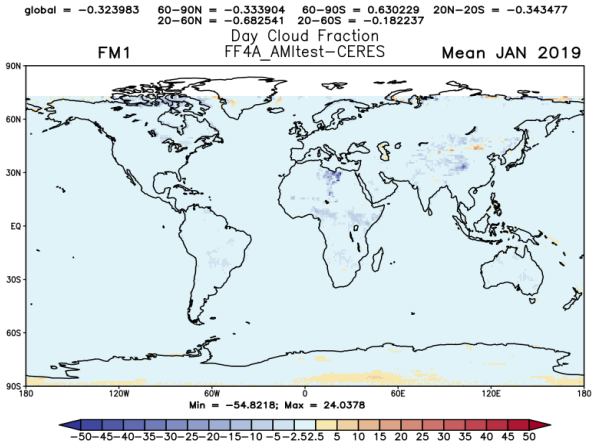
	4Anew- 4Aold Mean / Std Dev (W m^{-2})	4Anew - FF3C Mean / Std Dev (W m^{-2})	4Anew-Ceres 4A Mean / Std Dev (W m^{-2})
TOA SW Up	-0.49 / 2.47	-0.46 / 7.49	-0.02 / 2.65
TOA LW Up	0.02 / 0.57	0.08 / 2.86	-0.17 / 1.45
Surf SW Dn	0.45 / 6.93	2.53 / 22.36	5.13 / 26.73
Surf LW Dn	0.57 / 1.61	4.31 / 10.42	0.53 / 8.60

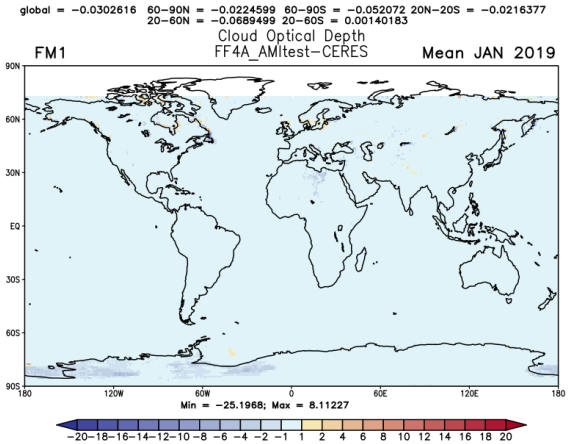
FM1 SSF Daytime Cloud Cloud Differences (Jan 2019)

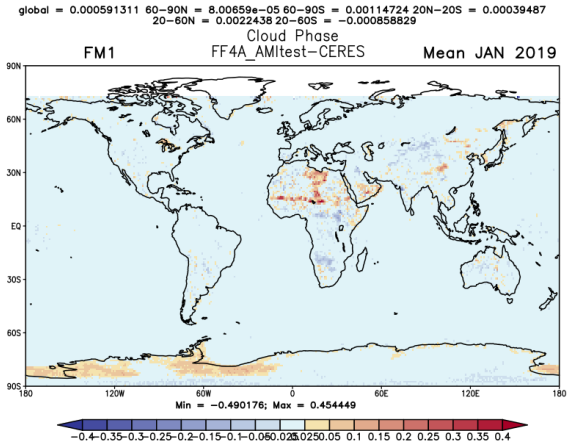




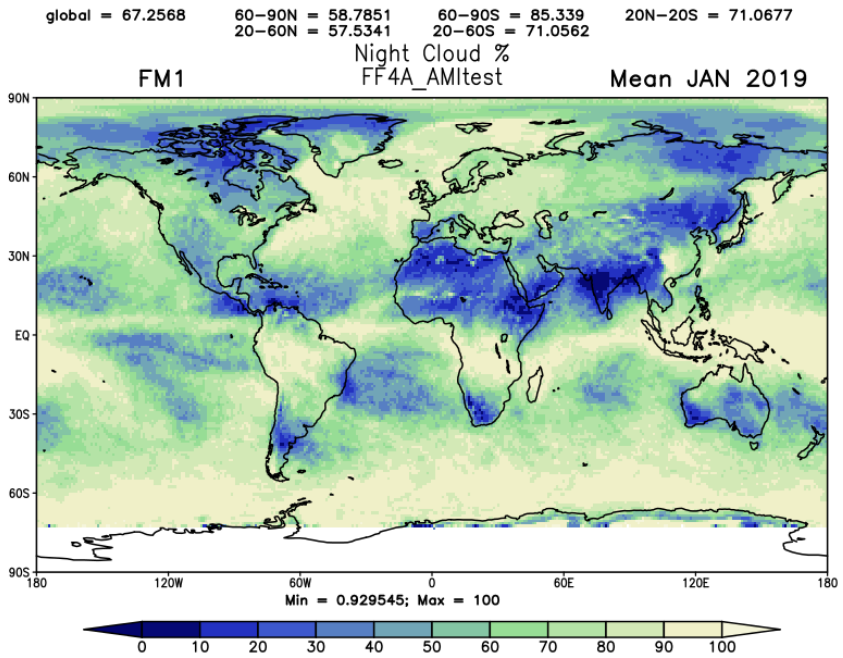


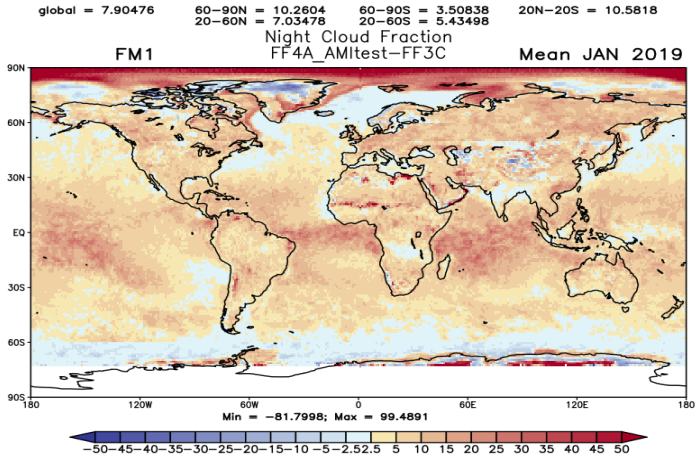


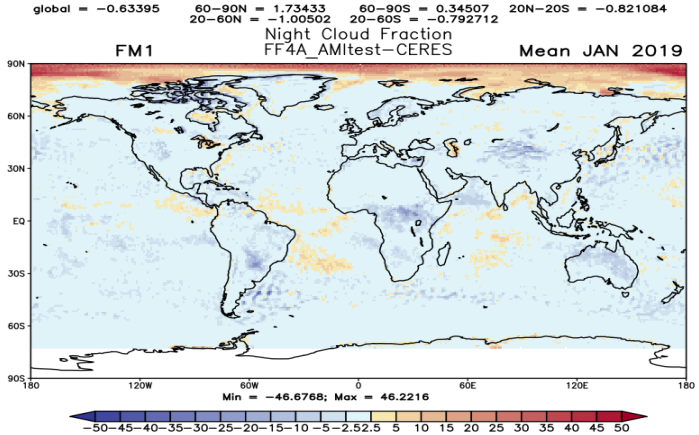




FM1 SSF Nighttime Cloud Cloud Differences (Jan 2019)

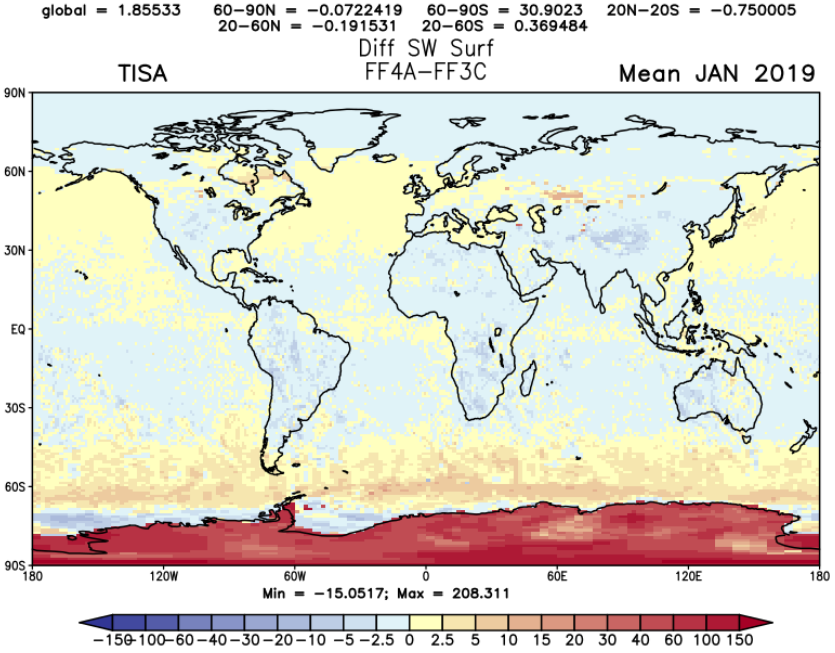




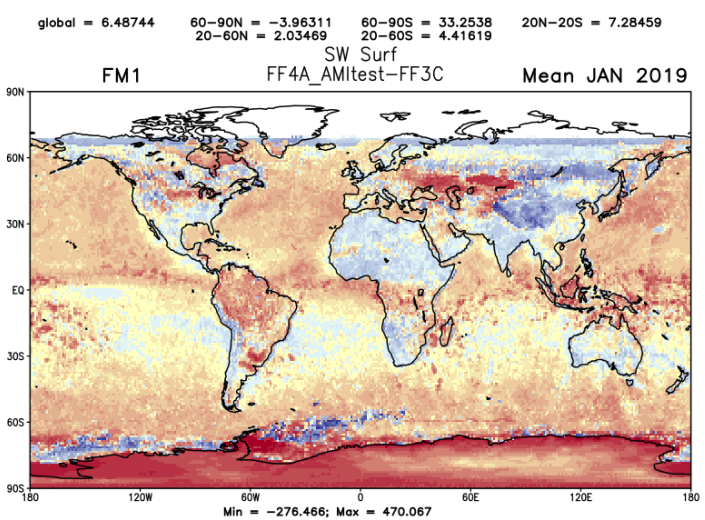


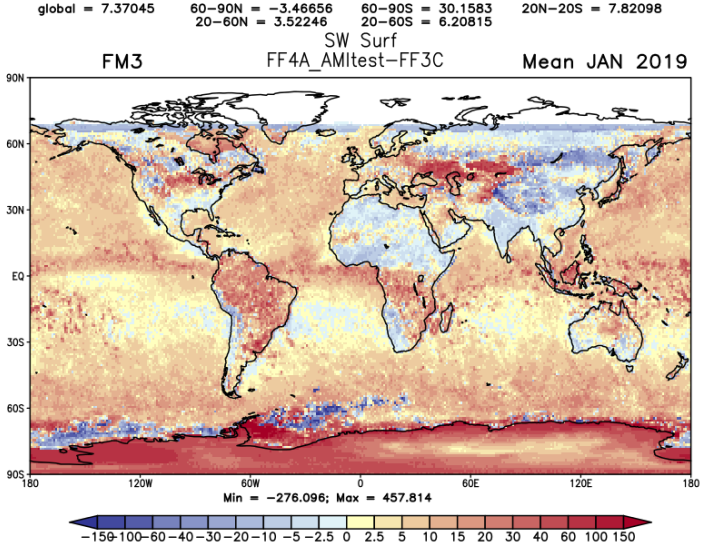
TISA Daily Surface SW Fluxes

TISA SW surface fluxes do not show large changes that SSF fluxes; grid box averaging changes Model B performance, temporal averaging smooths



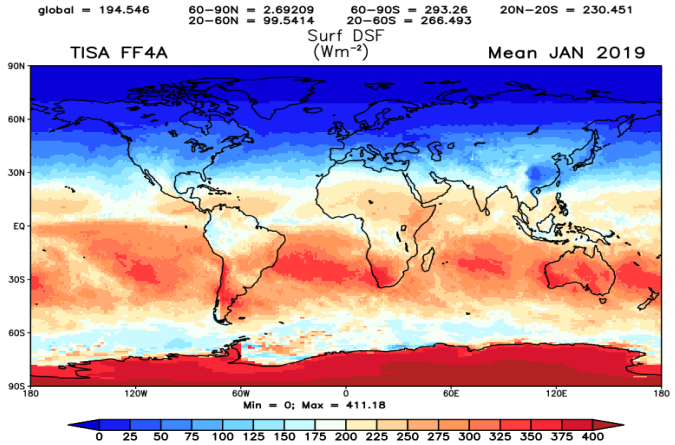
Increased daytime polar fluxes due to algorithm change



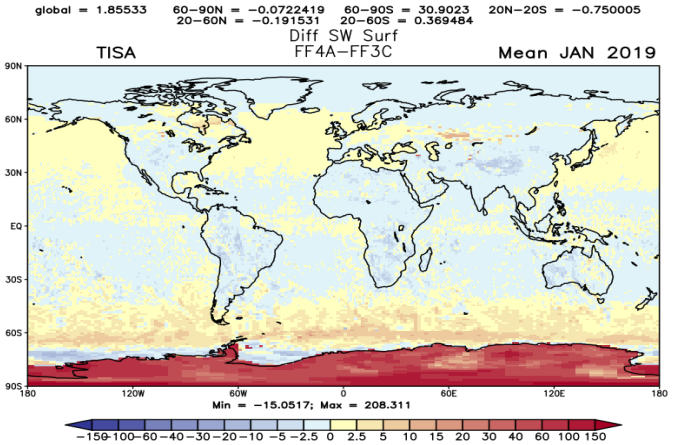


TISA SW Surface Flux Comparisons

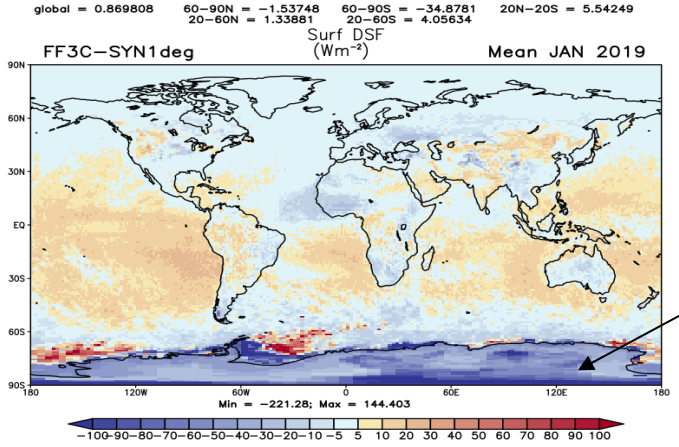
Monthly Mean Surface SW Down



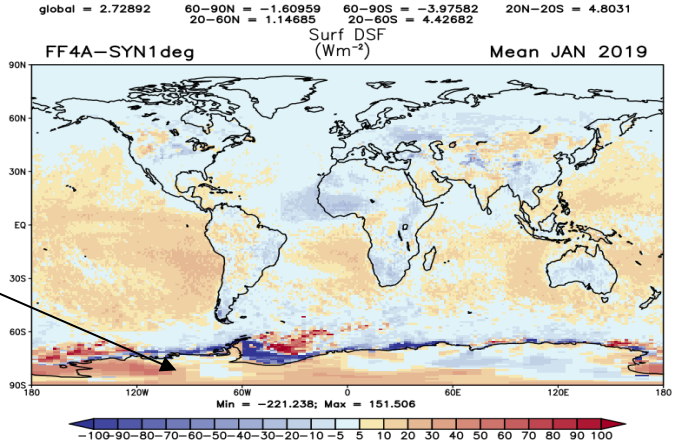
FFv4C global mean larger than FF v3C by about 2 W m^{-2}



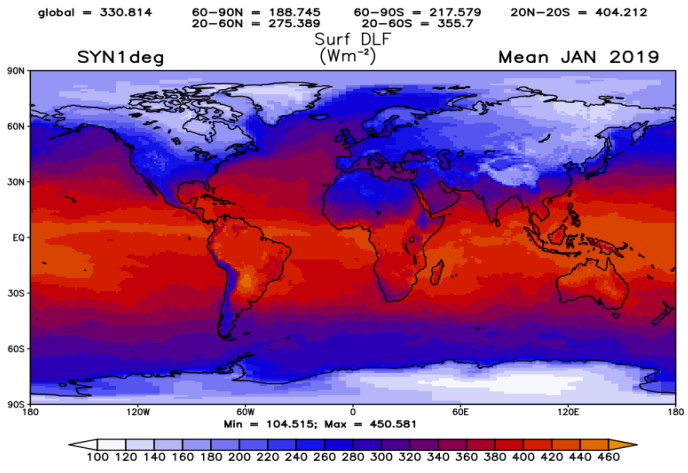
FFv3C compared to SYN1Deg

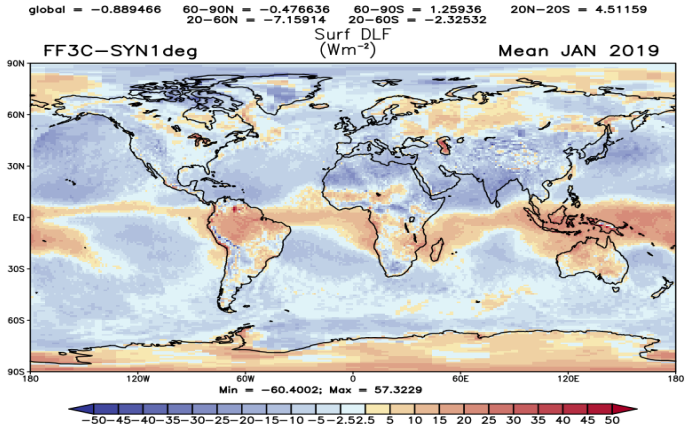


Daytime polar fluxes improved



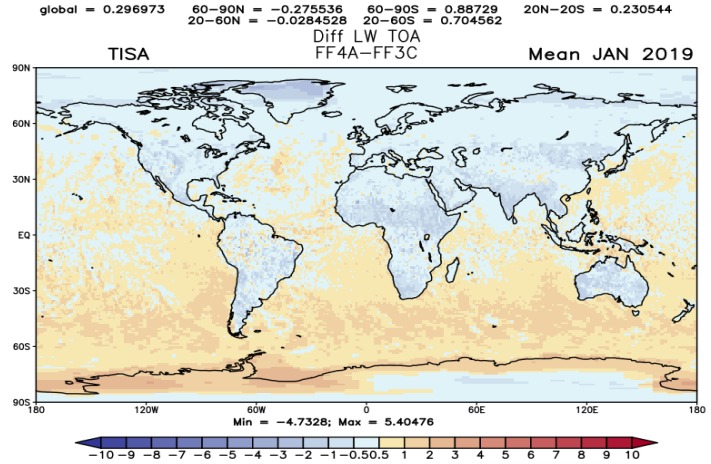
TISA LW Surface Flux Comparisons

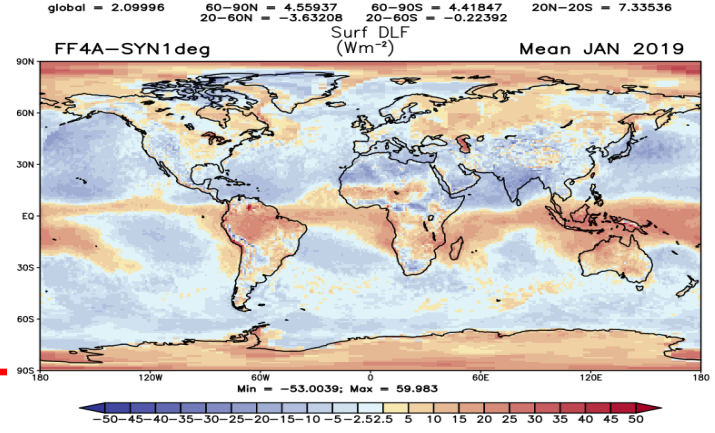




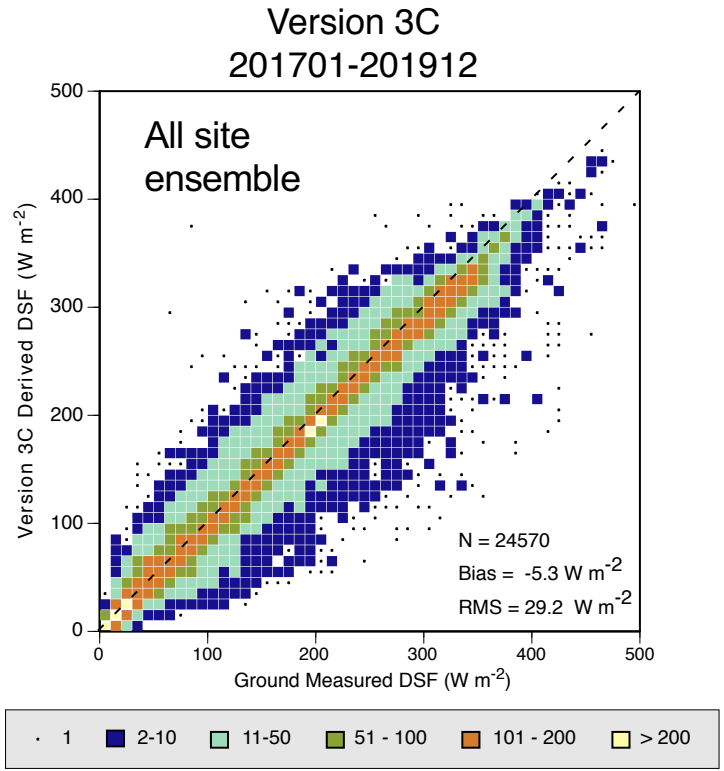
DLF differences relatively small

Difference patterns with Syn1deg very similar; MOA, Arctic night-time clouds





FF V3C SW Validation: 1/2017– 12/2019

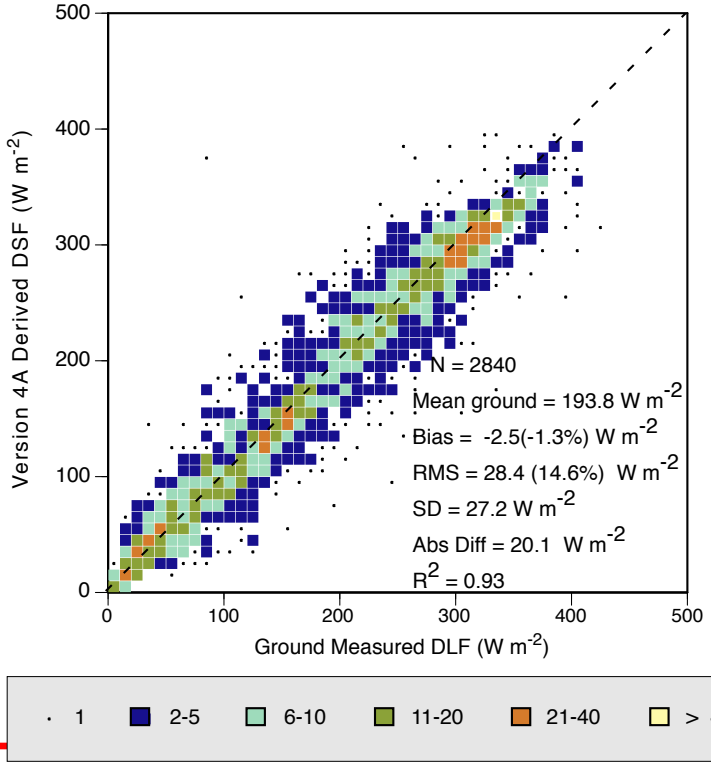


Daily Averaged TISA Comparison

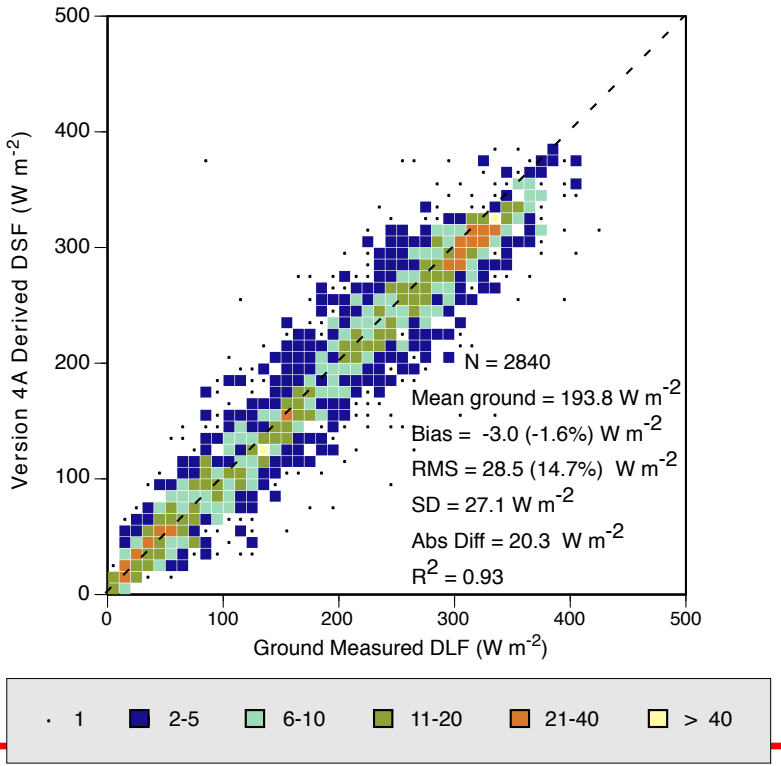
Ensemble Type	Bias (W m^{-2})	RMS (W m^{-2})	N
All Obs	-5.3	29.2	24570
Continental	-5.1	28.2	12913
Coastal	-3.8	24.2	4935
Desert	-6.1	21.9	3086
High Latitude	-19.6	51.0	1982
Island	6.5	26.4	1654

TISA Surface Shortwave Down Validation v3C vs v4A (Jan, Apr, Jul 2019)

Version 3C
2019 1, 4, 7



Version 4A
2019 1, 4, 7



TISA Surface Shortwave Down Validation v3C vs v4A (Jan, Apr, Jul 2019)

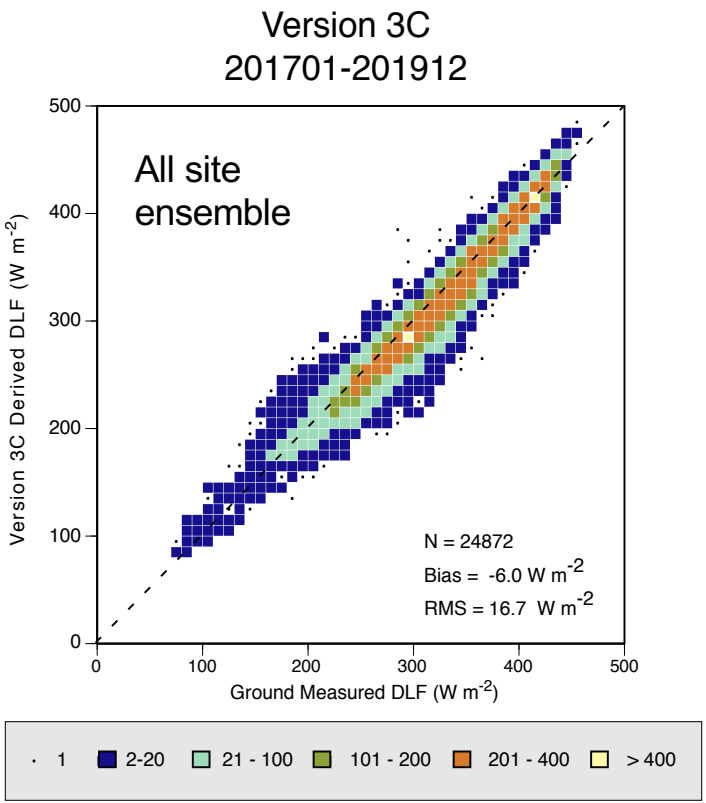
Ver3C

Ensemble type	N	Mean ($W m^{-2}$)	Bias ($W m^{-2}$)	RMS ($W m^{-2}$)	SD ($W m^{-2}$)	Abs Diff ($W m^{-2}$)	R^2
All Obs	2840	193.8	-2.5 (-1.3%)	28.4 (14.6%)	27.2	20.1	.93
Continental	1742	194.4	-1.9 (-1.0%)	28.4 (14.6%)	27.3	19.4	.93
Coastal	712	169.4	-2.5 (-1.5%)	26.2 (15.4%)	25.1	19.5	.93
Desert	150	297.5	-11.3 (3.8%)	28.7 (9.7%)	23.8	20.7	.80
High Latitude	147	175.2	-3.2 (-1.8%)	38.4 (21.9%)	36.2	31.1	.82
Island	89	234.0	1.3 (0.6%)	24.9 (10.7%)	24.2	17.9	.88

Ver4A

Ensemble type	N	Mean ($W m^{-2}$)	Bias ($W m^{-2}$)	RMS ($W m^{-2}$)	SD ($W m^{-2}$)	Abs Diff ($W m^{-2}$)	R^2
All Obs	2840	193.8	-3.0 (-1.6%)	28.5 (14.7%)	27.1	20.3	.93
Continental	1742	194.4	-3.0 (-1.5%)	28.6 (14.7%)	27.2	19.6	.93
Coastal	712	169.4	-3.4 (-2.0%)	26.1 (15.4%)	24.7	19.8	.93
Desert	150	297.5	-11.2 (-3.8%)	29.2 (9.8%)	24.0	20.9	.79
High Latitude	147	175.2	3.9 (2.2%)	38.0 (21.7%)	37.2	31.2	.83
Island	89	234.0	1.1 (0.5%)	24.7 (10.6%)	23.7	17.9	.93

FF V3C LW Validation: 1/2017 –12/2019

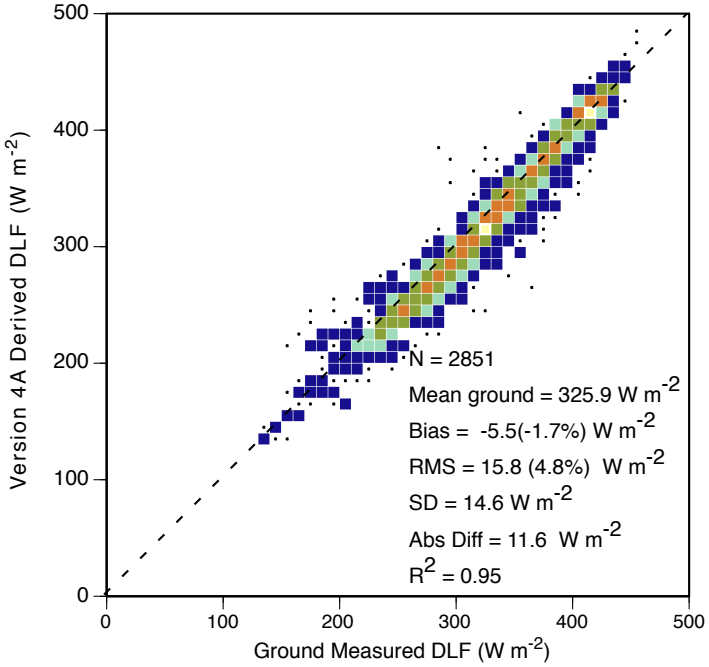


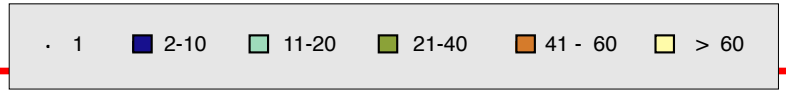
Daily Averaged TISA Comparison

Ensemble Type	Bias (W m^{-2})	RMS (W m^{-2})	N
All Obs	-6.0	16.7	24872
Continental	-9.6	18.0	12620
Coastal	-3.0	12.4	4921
Desert	-7.2	16.4	3015
High Latitude	4.0	20.7	2657
Island	-1.8	10.3	1659

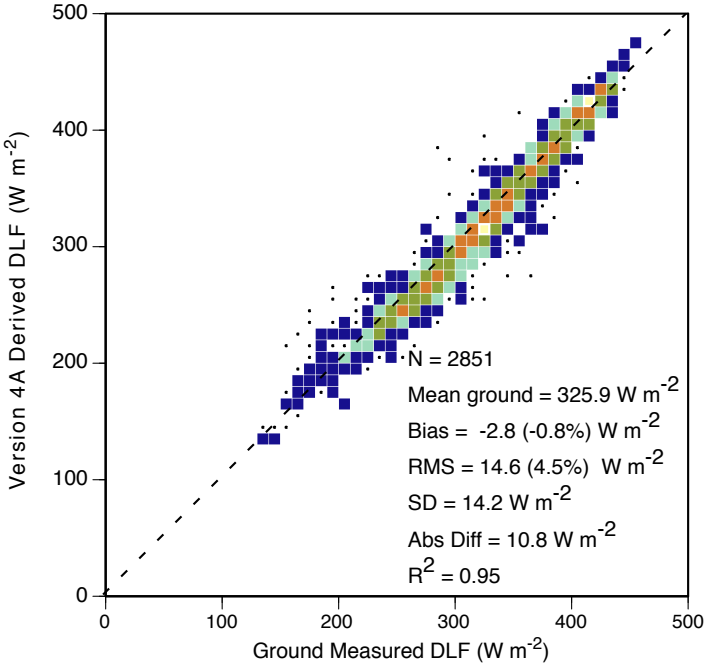
TISA Surface Shortwave Down Validation v3C vs v4A (Jan, Apr, Jul 2019)

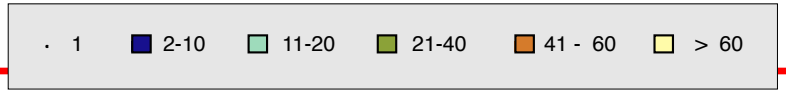
Version 3C
2019 1,4,7





Version 4A
2019 1, 4, 7





TISA Surface Shortwave Down Validation v3C vs v4A (Jan, Apr, Jul 2019)

Ver3C

Ensemble type	N	Mean (W m^{-2})	Bias (W m^{-2})	RMS (W m^{-2})	SD (W m^{-2})	Abs Diff (W m^{-2})	R^2
All Obs	2851	325.9	-5.5 (-1.7%)	15.8 (4.8%)	14.6	11.6	.95
Continental	1714	324.0	-8.0 (-2.5%)	17.0 (5.3%)	14.7	12.5	.94
Coastal	703	342.0	-2.8 (-0.8%)	12.5 (3.6%)	11.9	9.7	.95
Desert	137	328.0	-4.0 (-1.2%)	14.0 (4.3%)	12.7	11.8	.94
High Latitude	208	256.6	1.3 (0.5%)	18.3 (7.1%)	16.2	13.0	.91
Island	89	395.3	1.6 (0.4%)	8.3 (2.1%)	7.8	7.1	.94

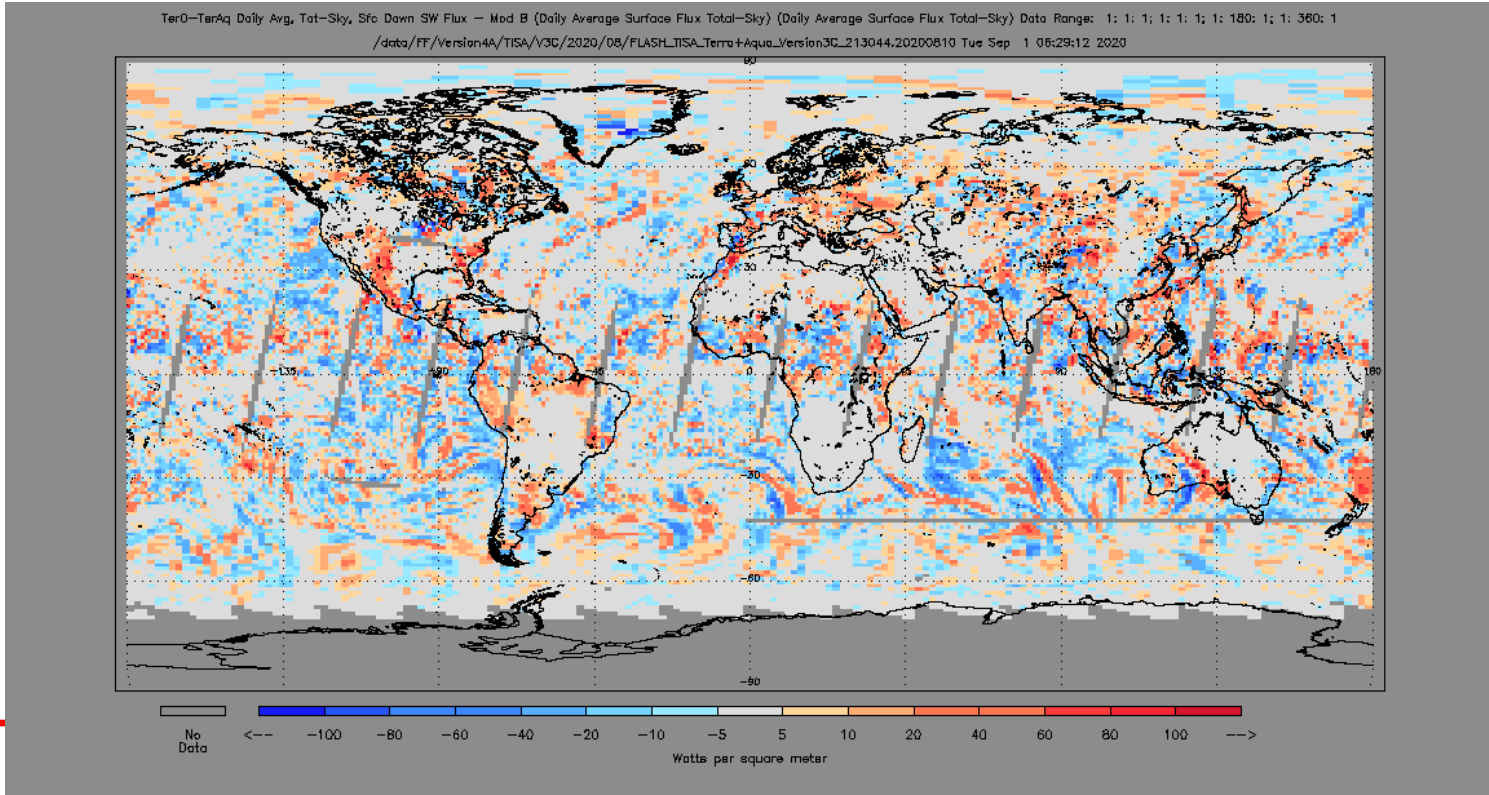
Ver4A

Ensemble type	N	Mean (W m^{-2})	Bias (W m^{-2})	RMS (W m^{-2})	SD (W m^{-2})	Abs Diff (W m^{-2})	R^2
All Obs	2851	325.9	-2.8 (-0.8%)	14.6 (4.5%)	14.2	10.8	.95
Continental	1714	324.0	-4.9 (-1.5%)	15.3(4.7%)	14.2	4.4	.95
Coastal	703	342.0	-0.4 (-0.1%)	11.6 (3.4%)	11.4	9.1	.97
Desert	137	328.0	-2.9 (-0.9%)	15.0 (4.6%)	14.0	12.3	.93
High Latitude	208	256.6	4.3 (1.7%)	18.7 (7.3%)	15.7	13.3	.91
Island	89	395.3	3.8 (1.0%)	8.9 (2.2%)	7.6	7.5	.94

Aqua Gap Issue (8/16 – 9/2)

Since Aqua missing from 8/16 through 9/2 must reconfigure to run TISA Terra-only Minus Terra+Aqua. Compared Terra-only to Terra+Aqua TISA fluxes

Surface SW Differences Terra-only – Terra+Aqua SWTOA – 8/10/2020



Aqua Gap Issue (8/16 – 9/2)

Since Aqua missing from 8/16 through 9/2 must reconfigure to run TISA Terra-only Minus Terra+Aqua. Compared Terra-only to Terra+Aqua TISA fluxes

Stats by Flux Component – 8/10/2020

Flux Component	Mean Difference	Standard Deviation	Maximum difference	Minimum difference
TOA SW up	-0.2	10.4	106.0	-112.0
TOA LW up	0.8	6.0	67.5	-71.9
Surf SW down	0.2	15.7	164.8	-146.3
Surf LW down	0.8	5.1	30.0	-36.0

NOAA-20 FF SSF Status

- ***MOA – same as FF Aqua/Terra from GMAO FP-IT***
- ***Clouds v1 VIIRS (NOAA-20) configured***
  - MOA input adapted
  - Other inputs configured
- ***Inversion (NOAA-20) being modified***
  - Accept MOA
  - Modifed SOFA Model B SW algorithm required
- ***Test 1: Offline MOA to Inversion run => 1-2 weeks away***
- ***TISA***
  - Should run with Ed4 SSFA/B files from NOAA-20

Summary and Conclusions

- ***FLASHFlux 3C and 4A progress***
  - Ceased TISA v3C processing on August 15, 2020 (SSF Terra through 9/6)
  - V4A is compatible with CERES Ed 4; uses MODIS Collection 6.1
  - V4A now processing August 1, 2020 (Jan, Apr, Jul, Oct 2019 also processed)
  - SSF comparisons show good agreement at TOA for SW and LW if calibration updated
  - SSF surface fluxes show significant changes in SW Surf; especially over ice, still evaluating
  - TISA LW and SW v4A at or better relative to 3 months of validation
  - Production plan for TISA: 1) Terra+Aqua 8/1-8/15, 2) Terra-only 8/16-9/2, 3) Terra+Aqua 9/3 on, 4) Evaluate using NOAA-20 to replace Aqua, 5) possible reprocess Dec 2019 to July 2020
- ***FLASHFlux Applications:***
  - Datasets continuing being distributed through POWER web services; Aqua gap at least temporarily to be filled with Terra-only; evaluate to add NOAA-20
  - CERES FF ordering past year ~82,000 unique ISP; nearly 26M orders; >60% low latency
- ***FLASHFlux Publications:***
  - 2019 SotC report published

FLASHFlux Web Sites

now moved to under CERES page

https://ceres.larc.nasa.gov/data/#fast-longwave-and-shortwave-flux-flashflux

Data also served through
https://power.nasa.gov